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$f[\phi(R), g]$ . Hence it follows that the evolution itself is a function (F) of the reproductive force and the social force of gravitation,  $E = F(R, g)$ . In consequence of this we may say, conversely,  $R = \Psi(E, g)$ , where  $\Psi$  expresses the function represented by  $R$ ." The last of these equations is marked III, being the third and last of the great formulas arrived at by Mr. Nossig.

We cannot take leave of Mr. Nossig without an apology to our readers for having given him so much space; but our defence is twofold. In the first place, it seemed worth while to stigmatize even so worthless a production when it had been accorded forty pages of space in *Kosmos*; and, secondly, although Nossig's childish endeavors at theory-making serve to expose his incapacity for scientific thought, his criticisms are not unfair specimens of a large part of anti-Malthus literature.

In speaking of Mr. Bonar's book there is less occasion for criticism than for description. It is not intended as an original contribution to the discussion, but as an account of the discussion as it has actually taken place; though, to be sure, there are not wanting passages in which the author gives his own judgment upon the merits of rival arguments. He narrates how Malthus' first essay on population arose out of debates between Malthus and his father on the opinions of William Godwin, and shows how the impression produced by this first essay decided the bent of its author's life, and how the second essay, published five years later (in 1803), differed from the first through being the embodiment of extensive personal observation as well as reading and reflection. This is followed by a detailed account of the larger essay, so far as it relates immediately to the question of population in a narrow sense; and after this we have a summary of Malthus' views on the greatest economic questions, not only as they appeared in his great essay, but also as he presented them in his other works. We shall not attempt to give a summary of a summary, but it may be worth while to direct attention to one or two points which will perhaps be surprising to those who fancy that humanity and moderation are a new thing in political economists. To such men it may sound strange to hear that "to Malthus the discovery of truth was less important than the improvement of society. When an economical truth could not be made a means of improvement, he seems to have lost interest in it." Nor will they be less surprised to learn that he had "the virtue of refusing to join the economical Pharisees, who would not admit the elasticity of economic laws, lest they should discredit their science." And though it is the followers of

Ricardo whom Mr. Bonar here designates as the economical Pharisees, one may profitably ponder the words which Mr. Bonar quotes from a letter written by Ricardo to Malthus: "Our differences may, in some respects, I think, be ascribed to your considering my book as more practical than I intended it to be. My object was to elucidate principles; and to do this I imagined strong cases, that I might show the operation of these principles." The misfortune of the matter is not that the critics, but that the followers, of Ricardo imagined his book to be 'more practical than he intended'; and thus it has happened that economists of the present generation, finding as the most conspicuous effect of Ricardian teaching the prevalence of certain practical dogmas, have thought that in exposing the untenability of these dogmas they were overthrowing the scientific method on which the theory of political economy had been built up.

The last three chapters of Mr. Bonar's book are devoted respectively to Malthus' views in moral and political philosophy, to 'the critics,' and to the biography of Malthus. The chapter on the critics is one of the most interesting in the book. The whole work shows evidence of the most minute and painstaking study: in fact, it would, we are convinced, have been decidedly more useful had the author not been quite so well informed as to the exact changes made in successive editions, and had he omitted many details which were necessary in the time of Malthus, but which are without interest now. The book might, without loss, have been greatly abridged; and, as the main service it will render is to make Malthus more readily accessible, this would have been an important improvement.

#### THE FORMS OF SHIPS FOR WAR AND FOR PEACE.

AMONG a collection of very valuable papers recently published by the British institution of civil engineers, is a report of a lecture of exceptional value by the great naval architect, Sir Edward J. Reed. The address was a short one, but very comprehensive. The speaker begins by comparing the conditions affecting the long and the short ship of equal weight-carrying power, showing that the character of the work for which the vessel is intended, and even the nature of the material of which its hull is composed, are circumstances affecting the form of maximum efficiency. The long ship of small wave-making action, but of great friction-producing power, is shown to be best for the case of light hull and heavy loading: the short, broad vessel, on the

other hand, is best for the case of the heavily plated, lightly loaded ship. The heavier the armor, the shorter and broader, proportionately, must be the hull chosen to do the best work. The fact that the shorter and broader, though for a given displacement the lighter, ship demands greater engine-power, brings another complication into the problem; and it is for the naval architect and engineer to seek the form which, on the whole, will be best for his purpose. On the whole, it is found that, for war-vessels, the heavier the armor to be carried, the fuller the form to be chosen: in other words, the value of a ship for purposes of war is not to be judged at all by the magnitude of the so-called 'constant of performance' (cube of the speed, multiplied by the two-thirds power of the displacement, divided by the indicated horse-power). A ship with a high coefficient may be a very bad vessel for war purposes, even though easily propelled through the water. This is a very important principle in naval architecture, and is the more to be kept in view from the fact that it has been customary for many years to judge the value of a design by the magnitude of this constant or some similar quantity. The application of a correct method of comparison shows the Belerophon, a short ship of 300 feet length, to be superior as a war-vessel to the Minotaur,—a ship of 400 feet length, and of much finer form. The smaller ship was 'handier,' attained the same speed, carried an equal battery better protected, had the same engine-power, and cost less than three-quarters as much as the larger. But her coefficient was about 15 per cent lower. This comparison effected a revolution in the naval design of Great Britain. The later iron-clads are built with a length only about five times the breadth, though steaming 16 and 17 knots.

It is found, on carrying out the investigation, that the short, broad ship, which should be given, nevertheless, fine 'entrance' and 'run,' may often be subject to less resistance than a rival craft of greater length and less beam. This was shown by Froude's experiments on the Ajax and a rival form. The magnitude and position of the 'bow wave' relative to the stern of the ship is one of the important modifying conditions. Should that wave take the right position, the resistance may be much less than where it comes in the wrong place. The action of the screw, in relieving the pressure of the water under the stern, is another serious consideration. Froude found, that, if it could be placed one-fourth or one-third the ship's beam from the stern of the vessel, the resistance to propulsion would be very much decreased. The introduction of a lengthened middle body may or may not aid; but no principle or formula

has yet been found to determine what the effect will be.

Of the three principal elements of resistance, the friction of the skin of the ship, the wave-making effect, the eddy resistance, the first is usually the greatest. In very fast vessels the second and third may approximate to equality with the first. At low speeds the friction may be nine-tenths the total: at high speeds, such as now are becoming common, the frictional resistance may become as low as one-half the total. Comparing war-vessels, it is seen that fine-lined ships having thick armor would require to be of enormous length, size, cost, and power, while the same offensive and defensive power may be obtained in full-lined ships at much less sacrifice of all desirable qualities.

No insuperable obstacles exist to-day to the production of armored war-vessels capable of defying all the ordnance of the world, and of carrying their own armament at a speed of 18 or 20 knots into the waters of any enemy. The cost of such vessels has become so great, however, that progress in this direction has apparently nearly or quite ceased for the present. The engineer and naval architect is prepared to do his part of the work whenever the nation shall call upon him.

This was the closing lecture of a course covering the general subject of hydromechanics, and was considered a very fitting final address.

#### MEDICAL MISSIONARY WORK IN CHINA.

IN 1881 Dr. Elizabeth Reifsnyder graduated in medicine from the Woman's medical college of Pennsylvania. Two years afterward she went as a medical missionary to Shanghai, where she is in charge of a new and handsome hospital. On Oct. 25, 1884, she performed the first ovariotomy ever done in northern China. The subject was thirty-one years of age, and travelled about five hundred miles to see Dr. Reifsnyder. The tumor weighed thirty-three pounds, and eleven days after the operation the patient sat up.

A successful operation like this soon made her famous, and the Chinese published accounts of the case. From one of these pamphlets the annexed cut is reproduced. It is evidently an ideal sketch by a native artist of great capacity, and vies in its amusing misrepresentation with some of the manufactured conversations of the modern interviewer.

It is *al fresco*; and evidently two passers-by—an Englishman and a Scotchman, to judge by their looks—have been attracted by the sight, and are watching it from the street. But the doctor's attitude and dress are the most amusing things in